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Nonindustrial Sources of Potentially Toxic Substances and Their Applicability to Source Apportionment Methods

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This project examined this extension of the receptor models and collected data on the emission sources of potentially toxic substances.

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Office Of Air And Radiation
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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
2.0	POTENTIALLY TOXIC SUBSTANCES, SOURCES, AND RECEPTOR MODELS	2
	2.1 Potentially Toxic Substances	2
	2.2 Naturally Occurring Toxic Substances	3
	2.2.1 Asbestos	3
	2.2.2 The Elements	3
	2.2.3 Radionuclides	3
	2.2.4 Organic Substances	3
	2.3 Sources	3
	2.4 Use of the Information	6
	2.4.1 Step 1 -- Collect Ambient Data	7
	2.4.2 Steps 2 and 3 -- List Emissions Sources	7
	2.4.3 Step 4 -- Elimination of Sources	7
	2.4.4 Step 5 -- Atmospheric Stability and Emission Continuity	8
	2.4.5 Step 6 -- Compatability With Receptor Models	8
	2.4.6 An Example	9
3.0	LITERATURE CITATIONS - SOURCES OF NONINDUSTRIAL TOXIC POLLUTANT EMISSIONS	12
4.0	REFERENCES	41
APPENDIX		47

LIST OF TABLES

Table		Page
2.1	Potentially Toxic Substances Studied in This Project	2
2.2	Abundances of Potentially Toxic Elements in Natural Substances	4
2.3	Radionuclides in Natural Substances	5
2.4	Nonindustrial Sources of Potentially Toxic Substances	7
2.5	Potential Sources of Potentially Toxic Substance Emissions in Example	10
2.6	Possible Sources of Potentially Toxic Substance Emissions in Example	11
3.1	Literature Citations - Nonindustrial Sources of Potentially Toxic Substance Emissions	13
3.2	Literature Citations - Nonindustrial Sources of Acetaldehyde Emissions	14
3.3	Literature Citations - Nonindustrial Sources of Asbestos Emissions	15
3.4	Literature Citations - Nonindustrial Sources of Arsenic Emissions	16
3.5	Literature Citations - Nonindustrial Sources of Benzene Emissions	17
3.6	Literature Citations - Nonindustrial Sources of Beryllium Emissions	18
3.7	Literature Citations - Nonindustrial Sources of Cadmium Emissions	19
3.8	Literature Citations - Nonindustrial Sources of Carbon Tetrachloride Emissions	20
3.9	Literature Citations - Nonindustrial Sources of Chlorobenzene Emissions	21
3.10	Literature Citations - Nonindustrial Sources of Chloroform Emissions	22
3.11	Literature Citations - Nonindustrial Sources of Chromium Emissions	24
3.12	Literature Citations - Nonindustrial Sources of POM Emissions	25
3.13	Literature Citations - Nonindustrial Sources of Dioxins Emissions	26
3.14	Literature Citations - Nonindustrial Sources of Formaldehyde Emissions	27
3.15	Literature Citations - Nonindustrial Sources of Manganese Emissions	28
3.16	Literature Citations - Nonindustrial Sources of Mercury Emissions	29
3.17	Literature Citations - Nonindustrial Sources of Methyl Chloride Emissions	30
3.18	Literature Citations - Nonindustrial Sources of Methyl Chloroform Emissions	31
3.19	Literature Citations - Nonindustrial Sources of Methylene Chloride Emissions	32
3.20	Literature Citations - Nonindustrial Sources of Nickel Emissions	33
3.21	Literature Citations - Nonindustrial Sources of Perchloroethylene Emissions	34

LIST OF TABLES (Continued)

Table		Page
3.22	Literature Citations - Nonindustrial Sources of Phenol Emissions	35
3.23	Literature Citations - Nonindustrial Sources of Polychlorinated Biphenyl Emissions	36
3.24	Literature Citations - Nonindustrial Sources of Radionuclides Emissions	37
3.25	Literature Citations - Nonindustrial Sources of Toluene Emissions	38
3.26	Literature Citations - Nonindustrial Sources of Trichloroethylene Emissions	39
3.27	Literature Citations - Nonindustrial Sources of Xylene Emissions	40
A.1	Industrial Emission Sources of Potentially Toxic Substances	47
A.2	Industrial Sources of Acetaldehyde Emissions	68
A.3	Industrial Sources of Acrolein Emissions	68
A.4	Industrial Sources of Acrylonitrile Emissions	69
A.5	Industrial Sources of Allyl Chloride Emissions	69
A.6	Industrial Sources of Arsenic Emissions	70
A.7	Industrial Sources of Asbestos Emissions	70
A.8	Industrial Sources of Benzene Emissions	71
A.9	Industrial Sources of Benzyl Chloride Emissions	72
A.10	Industrial Sources of Beryllium Emissions	72
A.11	Industrial Sources of Cadmium Emissions	73
A.12	Industrial Sources of Carbon Tetrachloride Emissions	73
A.13	Industrial Sources of Chlorobenzene Emissions	74
A.14	Industrial Sources of Chloroform Emissions	74
A.15	Industrial Sources of Chloroprene Emissions	74
A.16	Industrial Sources of Chromium Emissions	75
A.17	Industrial Sources of Coke Oven Emissions	75
A.18	Industrial Sources of o-,m-,p- Cresol Emissions	76
A.19	Industrial Sources of p-Dichlorobenzene Emissions	76
A.20	Industrial Sources of Dimethyl Nitrosamine Emissions	76
A.21	Industrial Sources of Dioxin Emissions	77
A.22	Industrial Sources of Epichlorohydrin Emissions	77
A.23	Industrial Sources of Ethylene Dichloride Emissions	77
A.24	Industrial Sources of Ethylene Oxide Emissions	78
A.25	Industrial Sources of Formaldehyde Emissions	79
A.26	Industrial Sources of Hexachlorocyclopentadiene Emissions	80
A.27	Industrial Sources of Maleic Anhydride Emissions	80
A.28	Industrial Sources of Manganese Emissions	81
A.29	Industrial Sources of Mercury Emissions	82
A.30	Industrial Sources of Methyl Chloride Emissions	82
A.31	Industrial Sources of Methyl Chloroform Emissions	83
A.32	Industrial Sources of Methylene Chloride Emissions	83
A.33	Industrial Sources of Nickel Emissions	83
A.34	Industrial Sources of Nitrobenzene Emissions	84
A.35	Industrial Sources of Nitrosomorpholine Emissions	84

LIST OF TABLES (Continued)

Table		Page
A.36	Industrial Sources of Perchloroethylene Emissions	84
A.37	Industrial Sources of Phenol Emissions	85
A.38	Industrial Sources of Phosgene Emissions	85
A.39	Industrial Sources of Polychlorinated Biphenyl Emissions	86
A.40	Industrial Sources of Propylene Oxide Emissions	86
A.41	Industrial Sources of Radionuclide Emissions	86
A.42	Industrial Sources of Toluene Emissions	87
A.43	Industrial Sources of Trichloroethylene Emissions	87
A.44	Industrial Sources of Vinyl Chloride Emissions	88
A.45	Industrial Sources of Vinylidene Chloride Emissions	88
A.46	Industrial Sources of o-, m-, p-Xylene Emissions	88

1.0 INTRODUCTION

Receptor models have been successully used for the source apportionment of particulate matter. Based on this past success, an extension of the models to other pollutants, such as organic toxic substances, is desirable and may be possible. However, much additional work must be performed to account for the reactivities of many of the organic substances. Until the reactivities of the organic substances are considered in the receptor models, source apportionment of the reactive organic substances by existing receptor models is not practicable.

This project examined this extension of the receptor models and collected data on the emission sources of potentially toxic substances. The primary purposes of this project were to:

1) Collect emission-source data for nonindustrial sources of potentially toxic substances, so that these sources could be evaluated by the modeler,

2) Consider, on a general level, the applicability of source apportionment using toxic substances, and

3) List industrial sources of potentially toxic substance emissions.

The principal focus of the project was nonindustrial sources of potentially toxic substance emissions. Nonindustrial sources are those sources which are not directly associated with an industrial process and include such things as wastewater treatment facilities, waste disposal sites, and waste piles, as well as, natural sources (see Section 2.3). Fugitive emissions from product or raw material storage facilities were considered as industrial emissions.

The investigation of nonindustrial sources was initiated because the possibility existed that these sources could emit significant amounts of toxic substances, and that these emissions could impact receptor sites at great distances from the source, thereby confounding a receptor analysis. The information on nonindustrial sources presented in this report can be used to assist in source apportionment by alerting the receptor modeler to the potential interference by emissions from these sources and by allowing the modeler to adjust for nonindustrial emissions.

The emission data were collected from a variety of literature sources, and, therefore, their reliability can not be judged. In addition, the reactivities of the substances were not examined in this project.

During the performance of this project, a substantial amount of information on industrial sources of toxic substances was also collected. A highly generalized presentation of this information is presented in the Appendix.

2.0 POTENTIALLY TOXIC SUBSTANCES, SOURCES, AND RECEPTOR MODELS

During the performance of this project, a literature search was conducted, and data were collected on sources of potentially toxic-substance emissions. Both industrial and nonindustrial sources of potential toxics were studied.

2.1 POTENTIALLY TOXIC SUBSTANCES

Many potentially toxic substances exist. However, only the substances listed in Table 2.1 were examined in this project. Many of these substances (e.g., allyl chloride and benzyl chloride) are found only in the emissions from their own production or the production of similar substances, while other substances (e.g., benzene and metals) have wide-spread emission sources.

TABLE 2.1. POTENTIALLY TOXIC SUBSTANCES STUDIED IN THIS PROJECT

Acetaldehyde	Formaldehyde
Acrolein	Hexachlorocyclopentadiene
Acrylonitrile	Maleic Anhydride
Allyl Chloride	Manganese
Arsenic	Mercury
Asbestos	Methyl chloride
Benzene	Methyl chloroform
Benzyl Chloride	Methylene chloride
Beryllium	Nickel
Cadmium	Nitrobenzene
Carbon Tetrachloride	Nitrosomorpholine
Chlorobenzene	Perchloroethylene
Chloroform	Phenol
Chloroprene	Phosgene
Chromium	Polychlorinated biphenyls
Coke Oven Emissions (POM)	Propylene oxide
Cresol (o-,m-,p-)	Radionuclides
p-Dichlorobenzene	Toluene
Dimethyl nitrosamine	Trichloroethylene
Dioxin	Vinyl chloride
Epichlorohydrin	Vinylidene chloride
Ethylene dichloride	Xylene (o-, m-, p-)
Ethylene oxide	

2.2 NATURALLY OCCURRING TOXIC SUBSTANCES

Some of the potentially toxic substances listed in Table 2.1, particularly the metals, occur in a natural state and exist in many of the natural substances around us; such as rocks, the air, and the ocean. Generalized discussions of some of the potentially toxic substances are included below. These discussions present information on the relative abundance of these substances so that a comparison can be made to emission quantities. It should be noted that weathering or disturbance to these natural substances may cause their release.

2.2.1 Asbestos

Asbestos is a mineral "form" of several different minerals (e.g., amphiboles and crysotile). Asbestos minerals are common in ultramafic (i.e., containing less than 45 percent silica and composed essentially of ferrmagnesium silicates, metallic oxides and sulfides, and native metals) rocks, especially serpentenite, and occur as accessory minerals in a variety of fairly common rocks, such as soapstones and dunites. Close associations with talc and olivine make the asbestos minerals rather common.

2.2.2 The Elements

Most of the elements, which are listed as potentially toxic substances in Table 2.1, are relatively common. Their abundance in natural substances is shown in Table 2.2.

2.2.3 Radionuclides

Radionuclides exist in many natural substances. Table 2.3 compares the concentrations of common radionuclides in a number of these natural substances.

Radionuclides are also present in other natural sources besides those shown in Table 2.3. Seawater contains Rb, Th, U and Ra; daughter products (K^{40}--->Ar^{40} and Rb^{87}--->Sr^{87}) of the primodal parents will be found in rocks; and soils, oceans, and streams contain Be^{10} which is washed from the atmosphere by rain.[2]

2.2.4 Organic Substances

Certain potentially toxic organic substances may be naturally occurring to some degree. For example, POM and methyl chloride have both been reported to be emitted from erupting volcanoes.[27,52] POM has also been reported in the water of thermal geysers and in gold mine dust.[27,35] Methyl chloride was reported by one author to be primarily natural in origin with the ocean as a major source.[23]

2.3 SOURCES

Both industrial (including combustion and incineration) and nonindustrial emission sources were studied in this project. Industrial sources were limited to the actual process sources, while the ancillary processes, such as wastewater treatment and waste disposal sites, were considered to be nonindustrial sources.

TABLE 2.2. ABUNDANCES OF POTENTIALLY TOXIC ELEMENTS IN NATURAL SUBSTANCES[1,2]

Natural Source	Concentration of Toxic Elements (ppm,wt.)						
	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Nickel
Continental Crust	1.8	3.0	0.5	102	1,110	0.085	84
Seawater	3.0×10^{-3}	6×10^{-7}	1.1×10^{-4}	5×10^{-5}	2×10^{-3}	0.15-0.27	2×10^{-3}
Igneous Rocks							
Ultramafic	1.0	0.1	0.100	1600	1620	4×10^{-3}	2000
Basaltic	2.0	1.0	0.220	170	1500	7×10^{-3}	130
High-calcium granites	1.9	2.0	0.130	22	540	2.1×10^{-3}	15
Low-calcium granites	1.5	3.0	0.130	4.1	390	3.9×10^{-2}	4.5
Syenite	1.4	1.0	0.130	2	850	0.01	4
Sedimentary Rocks							
Shale	13.0	3.0	0.300	90	850	0.4	68
Sandstone	1.0	0.1	0.010	35	100	3×10^{-2}	2
Carbonate	1.0	0.1	0.035	11	1100	4×10^{-2}	20
Oceanic							
Carbonate	1.0	0.1	0.010	11	1000	0.01	30
Clay	13.0	2.6	0.420	90	6700	0.10	225
Oil[A]	0.01		0.010	0.3	0.1	0.022	10
Coal[A]	5		0.500	18	50	2	15

[A] Uncombusted

TABLE 2.3. RADIONUCLIDES IN NATURAL SUBSTANCES[2]

Natural Source	Concentration of Radionuclide (ppm wt.)				
	K^{40}	Rb^{87}	U^{238}*	Th^{232}	$Ac^{227\&228}$
Igneous Rocks					5×10^{-10}
Granite	3.2	140	3.0	11.0	$7\text{-}8\times10^{-10}$
Intermediate	2.7	110	1.8	6.3	
Basaltic	0.95	30	1.2	4.2	
Sedementary Rocks					
Sandstone	1.2	60	0.45	1.8	
Shale	2.9	140	3.7	12.0	
Limestone	0.3	3	2.2	1.7	
Average Crustal Abundance	1.9	74	1.7	6.0	
Minerals	A	A			
Zircon			100-6000	50-400	
Apatite			5-150	20-250	
Sphene			100-700	100-600	
Allanite			30-700	500-20,000	
Monazite			500-3000	25,000-200,000	

A K^{40} and Rb^{87} usually concentrate in mica and K-feldspar in granite rocks and plagioclase in basaltic rocks.

* U^{235} is always 0.71% as abundant as U^{238}.

Nonindustrial sources are listed in Table 2.4. Many of these sources (e.g., windblown dust) have variable types of emissions based on the types of materials on which the activity occurs.

TABLE 2.4. NONINDUSTRIAL SOURCES OF POTENTIALLY TOXIC SUBSTANCE EMISSIONS

Agricultural burning	Ocean
Agricultural tilling	Open burning
Aqueous systems	Paved roads
Building demolition	Pesticide application
Burning of treated wood	Plants
Coal refuse piles	Rainout and dry deposition
Cooling water	Rock weathering and vaporization
Degassing (soils)	Rubber tire dust
Disturbances of ore bodies	Sewage
Dumpsites and landfills	Soil
Dust (windblown)	Storage and spoils piles
Earth's crust	Swimming pools
Forest fires	Unpaved roads
Gas-fired appliances	Urban fires
Geysers and geothermal waters	Volcanoes
Microbial activity	Wastewater treatment
Mining dust and ore bodies	Woodburning fireplaces
Natural brines	

A detailed accounting of the potentially toxic pollutants and their sources is given in Section 3.0 for the nonindustrial sources. A generalized listing of industrial emission sources is presented in the Appendix.

2.4 USE OF THE INFORMATION

The potentially toxic metals (i.e., arsenic, beryllium, cadmium, chromium, manganese, mercury, and nickel) and their associations with particulate matter are currently being used for source apportionment. This report should assist in interpreting ambient variability of these elements by identifying possible natural sources. However, the organic substances have not been extensively used in source apportionment studies using receptor models.

The information collected by this project can be used to perform a preliminary assessment of the sources whose potentially toxic emissions could impact on a receptor site. This assessment can locate potential sources based on the matching of ambient results to source-emission data and can serve as a prescreening technique for more sophisticated approaches using receptor methods. As such, the information presented herein can be used to gain a qualitative understanding of an area's problems prior to the application of more quantitative receptor techniques.

An approach to performing this preliminary assessment is outlined in the following six-step approach.

1) Collect ambient data (after prescreening),

2) List all nonindustrial emission sources of at least one of the potentially toxic substances which were found in the ambient results,

3) List all industrial emission sources of at least one of the potentially toxic substances which were found in the ambient results,

4) Eliminate from consideration those sources which have no possibility of impacting the receptor site,

5) Examine the available data on atmospheric transformations of the substances, and

6) Examine the compatability of the remaining data with the receptor models to determine the potential sources of the compound.

2.4.1 Step 1 -- Collect Ambient Data

The collection of ambient data on the potentially toxic substances is an important first step in performing a preliminary assessment of an area's problems. However, the collection of ambient data for organic substances is expensive, and to moderate this expense, limitations on the number of substances must be imposed, and sampling sites must be carefully selected.

A prescreening technique can be used to limit the number of substances to be monitored. The prescreening can be done by examining the major sources in the area and by using the data tables in this report to list expected emissions.

Once the prescreening has been finished, limited dispersion modeling can be performed to assist in the selection of sampling sites. This modeling can be used to locate "hot spots".

Ambient sampling systems for organic substances are available. Although standardized methods are not available, acceptable methods are. Multiple samples are needed for some receptor models (e.g., factor analysis), and this should be considered when sampling networks are designed.

2.4.2 Steps 2 and 3 -- List Emission Sources

The potentially toxic substances identified in the analyses of the ambient samples are compared to the lists of both nonindustrial and industrial emission sources (see Tables 3.1 to 3.27 and A.1 to A.46, respectively). All sources which emit at least one of the substances collected in the ambient samples are included in a potential-source list of substances.

2.4.3 Step 4 -- Elimination of Sources

After the list of emission sources is completed, those sources whose emissions do not impact on the receptor sites are eliminated from consideration. Factors to be considered in the elimination are schedule of the plant (i.e., whether or not the plant was operating during the period of time that the sample was taken), terrain effects (e.g., channeling of emissions away from the receptor), and meterological conditions (e.g., wind direction away from the receptor).

2.4.4 Step 5 -- Atmospheric Stability and Emissions Continuity

Some potentially toxic substances are relatively stable during atmospheric transport, while others may be transformed into entirely different substances by atmospheric processes. Stability plus constant emissions make some substances good tracers. The characteristics of a good tracer are:

1) the chemical composition of the emissions is relatively constant over time,

2) the chemical composition is relatively stable during transport from the source to the receptor site, or if not stable, having predictable transformational characteristics, and

3) the substance is easily detected and quantified at the receptor site (availability of a reliable analytical technique and the presence of an adequate concentration to detect).

2.4.5 Step 6 -- Compatability With Receptor Models

A receptor model estimates the contributions of specific sources or source categories to ambient pollutant levels by relating the characteristics of the source emissions to the characteristics of the pollutants collected at the sampling (receptor) site. The monitors at the sampling site collect pollutants from an atmosphere containing the pollutants emitted from a variety of sources. Each source's emission fingerprint can then be used to apportion the contribution of each source to the mixed atmosphere at the sampling site.

Receptor models have been successfully applied to the source apportionment of particulate matter. Chemical Mass Balance (CMB) and factor analysis are two receptor-modeling approaches that have gained use and success with particulate matter. Both approaches have limitations when applied to gaseous substances (see additional reference list on page 51 for general source receptor titles).

The main limitation of both CMB and factor analysis is that they require relatively non-reactive pollutants for proper operation. For reactive pollutants, the models must be adjusted. Two methods of adjustment that appear to show promise are:

1. The use of a "decay factor" to account for reactions of the pollutants, and

2. The use of "surrogate" nonreactive pollutants and estimates of emission ratios between the reactive pollutants and the surrogates. This method provides a worst case estimate of the impacts of the gaseous substances.

The development of adjustments for reactive pollutants is in its infancy, and the success of these and other adjustments for reactive-pollutant receptor modeling is unknown.

For CMB, source "fingerprints" that express the relative contribution of each gaseous substance must be developed, and all sources used in the CMB must express their fingerprint as either a percent of the total

mass of gaseous emissions or as a percent of a given set of common substances. Relative contributions are sometimes difficult to obtain. Percentages (i.e. ppm) are needed. Many of the data in the emissions inventories are expressed in units of quantity of emissions per time. The great variety of organic substances also presents a problem in relating emissions to a common gaseous substance or in relating signatures of both solid and gaseous tracers from the same source.

The use of the CMB for the source apportionment based entirely on reactive, toxic, organic substances is possible. However, a new or modified methodology must be developed. Conceptionally, this strategy would involve developing fingerprints based on something other than percent of total mass (as discussed above) and the development of mathematical techniques that would accommodate the "adjustments" suggested above. This development is beyond the scope of this project.

The six-step approach outlined here would also assist in satisfying a major requirement for interpreting the results of factor analysis; knowledge of a source's characteristics. Three steps (i.e., steps 1, 2, and 3) provide this information. Step 1 provides preliminary data during the prescreening, and steps 2 and 3 provide more detailed source characterization data.

2.4.6 An Example

To demonstrate the use of the method outlined and proposed above, an example using a hypothetical situation is shown. Ambient measurements have shown the presence of carbon tetrachloride, methyl chloride, methyl chloroform, methylene chloride, perchloroethylene, and trichloroethylene in the atmosphere of a small, noncoastal, western U.S. town.

The emission sources of these organic substances are listed in Table 2.5 for industrial and nonindustrial sources. A search of the emissions inventory of the surrounding area revealed a petrochemical complex that produces a variety of petrochemicals, a pesticides plant, several dry cleaners, wastewater treament facilities, a municipal water-supply system, and several smaller facilities with uncertain operations.

From a detailed examination of the microinventory and the collection of additional data from a local control agency, it is found that the chief petrochemicals produced are carbon tetrachloride, chloroform, methyl chloride, methylene chloride, and trichloroethylene. During the sampling period, there were no forest or urban fires or volcanic activity to impact on the area. All plants and facilities were operating normally and unusual terrain or metereological conditions were not present. The effects of atmospheric reactivity transformation on the substances are unknown.

Based on the above observations, the potential sources in Table 2.5 can be reduced considerably. The possible sources of these toxic substances are shown in Table 2.6. Conceptionally, the relative contributions of each source can then be estimated using the adjusted receptor models.

Table 2.5 Potential Sources of Potentially Toxic Substance Emissions in Example

Sources	Toxic Substances					
	Carbon Tetrachloride	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Trichloro-ethylene	Perchloro-ethylene
Nonindustrial Sources						
Aqueous system	X					
Dry cleaning facilities						X
Forest fires				X		
Ocean		X				
Urban fires				X		
Volcanoes		X				
Wastewater treatment	X	X	X	X	X	X
Industrial Sources						
Production of:						
Acetaldehyde		X				
Cacodylic Acid		X				
Carbon tetrachloride	X	X	X	X		
Chloroform	X	X	X	X		
Chlorophenol	X					
Chlorotrifluoromethane	X					
Dichlorodifluoromethane	X					
DSMA		X				
Ethylene dichloride		X				
Floor waxes	X					
Methyl chloride	X	X	X	X		
Methyl chloroform			X		X	
Methylene chloride	X	X		X		
MSMA		X				
Paints, stains, & lacquers	X					
Paint & varnish removers			X	X		
Perchloroethylene					X	X
Pesticides	X	X	X	X		
Polishes (shoe & furniture)	X					
Rubber cement	X					
Tetraethyl/tetramethyl lead		X				
Trichloroethylene	X				X	
Trichloromethylene	X					
Vinyl acetate		X				
Iron foundries					X	
Metal degreasing	X		X	X	X	X
Solvent use	X					
Textiles - scouring & drycleaning	X				X	X

Table 2.6 Possible Sources of Potentially Toxic Substance Emissions in Example

Sources	Toxic Substances					
	Carbon Tetrachloride	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Trichloro-ethylene	Perchloro-ethylene
Nonindustrial Sources						
Aqueous system	X					
Dry cleaning facilities						X
Forest fires						
Ocean						
Urban fires						
Volcanoes						
Wastewater treatment	X	X	X	X	X	X
Industrial Sources						
Production of:						
Acetaldehyde						
Cacodylic Acid						
Carbon tetrachloride	X	X	X	X		
Chloroform	X	X	X	X		
Chlorophenol						
Chlorotrifluoromethane						
Dichlorodifluoromethane						
DSMA						
Ethylene dichloride						
Floor waxes						
Methyl chloride	X	X	X	X		
Methyl chloroform						
Methylene chloride	X	X		X		
MSMA						
Paints, stains, & lacquers						
Paint & varnish removers						
Perchloroethylene						
Pesticides	X	X	X	X		
Polishes (shoe & furniture)						
Rubber cement						
Tetraethyl/tetramethyl lead						
Trichloroethylene	X				X	
Trichloromethylene						
Vinyl acetate						
Iron foundries						
Metal degreasing						
Solvent use						
Textiles - scouring & drycleaning						

3.0 LITERATURE CITATIONS - SOURCES OF NONINDUSTRIAL TOXIC POLLUTANT EMISSIONS

Many of the potentially toxic pollutants listed in Table 2.1 are emitted or have the potential to be emitted from nonindustrial sources. Table 3.1 shows a generalized summary of nonindustrial sources of potentially toxic substances emissions. In this table, the author has taken certain liberties by indicating, with a (?), those toxic substances which may be present but are not specifically reported in the literature. Those marked with a (X) have been demonstrated, in the literature, as being emitted from a nonindustrial souce.

Tables 3.2 to 3.27 list the sources of emissions of each substance.

TABLE 3.1 LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF POTENTIALLY TOXIC SUBSTANCE EMISSIONS

Source	Acetaldehyde	Asbestos	Arsenic	Benzene	Beryllium	Cadmium	Carbon Tetrachloride	Chloroform	Chromium	Coke Oven Emission (POM's)	Dioxins	Formaldehyde	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Perchloro-ethylene	Phenol	Polychlorinated Biphenyls	Radionuclides	Toluene	Trichloro-ethylene	Xylene
Forest Fires	X		X	X						X	?	X					X						X		X
Open Burning				?	X	X		X	X	X	?	X						X							
Agricultural Burning			X		X	X			X	X	X	?	?	?				X							
Unpaved Roads		X			?	?							X					X							
Paved Roads		?			?	?			X	X			X												
Storage & Spoils Piles		X																X				X			
Steel Furnace			X		?	X			X				X	?				X							
Nonferrous slags			X		X	X			X				X	X				?							
Dumpsites/Landfills		X	?	?	?	?			?				?	X				?			X				
Wastewater Treatment				X			X	X		X	X				X	X	X	X	X	X			X	X	
Ocean			X												X							X			
Coal Refuse Piles			?		?	?				X	?		?	X				?							
Volcanoes			X		?	X			X	X			X	X	X			X				X			
Building Demolition		X																							
Pesticide Application			X							X				X											
Coal Ash			X		X				X		X		X	X				X				X			
Soil			X		?	X			X		X		X	X				?				X			
Dust			?		?	X			X		X		X	X				X							
Aqueous Systems							X	X																	
Swimming Pools								X		X															
Sewage														X											
Earth's Crust		?	X		?	?			?				?	?				?							
Plants, Soil, etc.			X																						
Disturbances of ore bodies		X	?		?	?			?				?	?				?							
Microbial Activity			X																						
Rainout & Dry Deposition			X																						
Cooling Water								X	X																
Geyers & Geothermal										X				X								X			
Natural Brines													X												
Woodburning Fireplaces										X	X														
Rubber Tire Dust										X															
Mining Dust & Ore Deposits		?	?		?	?				X			?	X				?							
Urban Fires	?	?	?	?		?				X	?	?	?	?			?	?					?		?
Gas-fired Appliances										X															
Burning Treated Wood											X														
Degassing-soils														X											
Rock Weathering & Vaporization		?	?		?	?							?	X				?				X			
Agricultural Tilling						X							X					X							

X Reported in literature as being present in emissions
? Possibly present in emissions; not reported in literature

TABLE 3.2 LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF ACETALDEHYDE EMISSIONS

Source	References
Forest Fires - Broadcast Burn	3

TABLE 3.3. NONINDUSTRIAL SOURCES OF ARSENIC EMISSIONS

Source	References
Pesticide application and residue*	8
Steelmaking Furnace Dust Residues**	
Open Hearth	9
Electric	9
Basic Oxygen	9
Ocean	
Bubble Bursting	10
Gas Exchange	10
Earth's Crust	
Particle Weathering	10
Direct Volatilization	10
Volcanoes	10
Gases	2
Mt. St. Helens - Aircraft samples	14
Mt. St. Helens - Ash fall	14
Volcanic Dust Flux	1
Volcanic Gas Flux	1
Forest Fires	10
Plants, Soil, etc.	10,11,12
Agricultural Burning	10
Volatilization by Aerobic & Annerobic Microbial Activity	10
Removal of As by Rainout and dry deposition	10
Nonferrous Metals Slags***	
Primary Copper - Reverb Slag	13
Primary Copper - Granulated Slag	13
Primary Lead - Blast Furn. Slag	13
Coal Ash	2
Soils	1

* Arsenic containing pesticides includes calcium, led, and sodium arsenates; desodium methylarsenate; ammonium methanearsenate; and arsanilic acid.

** Residues collected by air pollution control equipment and dumped in an open (usually) site. Possible wind-blown dust source.

*** Possible wind-blown dust source.

TABLE 3.4 LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF ASBESTOS EMISSIONS

Source	References
Unpaved Roads - Asbestos	4
containing road coverings	4
Disturbances of ore bodies*	4
Building demolition	6
Asbestos pipe plant	7

*Personal samples located on a large serpentenite outcrop in a Federal Recreation area.

TABLE 3.5. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF BENZENE EMISSIONS

Source	References
Forest Fires, Broadcast Burn	3
Loblolly Pine Smoke	15
Evaporation Ponds-Wood Treating	16
Emissions-Open Steaming Using Penta	16
-Closed Steaming Using Penta	16
Wastewater Treatment Facilities	
Industrial laundries	17
Coin-operated laundries	17
Mining preparation	17
Chlor-alkali diaphragm cell	17
Byproduct coking	17
Sintering	17
Blast furnace	17
BOF (wet suppressed)	17
Electric arc furnace	17
Vacuum degassing	17
Hot forming - primary	17
Hot forming section	17
Hot forming - flat	17
Hydrochloric acid pickling	17
Hot coating	17
Combination acid pickling	17
Kolene scale removal	17
Leather tanning and finishing	17
Iron and steel foundries	17
Aluminum foundries	17
Zinc casting	17
Tall oil rosins, fatty acids, and pitch	17
Pharmaceutical - formulation	17
Pharmaceutical - fermentation and synthesis	17
Primary aluminum	17
Secondary aluminum	17
Primary copper	17
Secondary copper	17
Secondary lead	17
Secondary silver	17
Primary tungsten	17
Primary zinc	17
Iron ore mining and dressing	17
Base and precious metals	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Rubber processing	
Emulsion crumb rubber	17
Solution crumb rubber	17
Utility boilers	17
Textiles	17

TABLE 3.6 LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF BERYLLIUM EMISSIONS

Source	References
Burning whole sugar cane	18
Burning sugar cane leaf trash	18
Coal ash	2
Magnesium slags	13
Agricultural open burning	19

TABLE 3.7. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF CADMIUM EMISSIONS

Source	References
Whole sugar cane burning	18
Sugar cane leaf trash burning	18
Nonferrous slags*	
Primary Copper - granulated	13
- reverb.	13
- electric	13
Primary Lead - blast furn.	13
- fresh Fuming	13
- old Fuming	13
Secondary Copper	13
Secondary Lead	13
Continental dust flux	1
Volcanic dust flux	1
Volcanic gas flux	1
Soil concentration	1
Agricultural open burning	19
Steel furnace dust disposal*	
Open hearth	9
Elecric arc	9
Primary Lead - ore concentrate storage	20
- sinter storage	20
- sinter dump area	20
Primary zinc - flue dust disposal	20
Secondary zinc - sweat furnace dust	20
Agricultural tilling	21

*Possible wind-blown dust source.

TABLE 3.8. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF CARBON TETRACHLORIDE

Source	References
Aqueous systems	6
Wastewater treatment facilities	
Industrial laundries	17
Alkaline mining	17
Chlor-alkali diaphragm cell	17
Open hearth furnace (semi-wet)	17
Vacuum degassing	17
Hot forming - primary	17
Hot forming - section	17
Hot forming - flat	17
Cold rolling	17
Combination acid pickling	17
Iron & steel foundries	17
Aluminum foundries	17
Zinc casting	17
Copper casting	17
Secondary aluminum	17
Primary columbium & tantalum	17
Primary copper	17
Secondary copper	17
Secondary silver	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Rubber processing	
Emulsion crumb rubber	17
Solution crumb rubber	17

TABLE 3.9. NONINDUSTRIAL SOURCES OF CHLOROBENZENE

Source	References
Wastewater treatment facililties	
Industrial laundries	17
Alkaline mining	17
Sintering	17
Hydrochloric acid pickling	17
Leather tanning and finishing	17
Pharmaceutical fermentation & chemical synthesis products	17
Primary copper	17
Secondary lead	17
Secondary silver	17
Pulp, paper, and paperboard	17
Utility boilers	17
Textiles	17

TABLE 3.10. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF CHLOROFORM

Source	References
Cooling water	22
Sewage	22
Drinking water	22
Swimming pools	22
Air conditioner exhaust	22
Power Plant (100mw)cooling tower	22
Vegetative burning	23
Burning of plastics	23
Wastewater treatment facilities	
Industrial laundries	17
Linen laundries	17
Power laundries	17
Diaper services	17
Coin operated laundries	17
Car washes	17
Mining preparation	17
Chlor-alkali cells	17
Byproduct coking	17
Sintering	
Blast furnace	17
BOF (wet open)	17
Electric arc (wet)	
Vacuum degassing	17
Hot forming - primary	17
Hot forming - section	17
Hot forming - flat	
Sulfuric acid pickling	17
Hydrochloric acid pickling	17
Cold rolling	17
Hot coating	17
Combination acid pickling	17
Kolene scale removal	17
Hydride scale removal	
Continuous alkaline	
Leather tanning and finishing	17
Iron and steel foundries	17
Aluminum foundries	17
Zinc casting	17
Porcelain enameling on copper	
Wood rosin, turpentine, and pine oil	17
Pharmaceutical Mfg.	
formulation	17
fermentation and chemical synthesis	17
fermentation, natural extraction, chemical synthesis and formulation	17
Primary aluminum	17
Secondary aluminum	17

TABLE 3.10. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF CHLOROFORM (Contd.)

Source	Reference
Wastewater treatment facilities (contd.)	
Primary columbian and tantalum	17
Primary copper	17
Secondary copper	17
Secondary lead	17
Secondary silver	17
Primary tungsten	17
Primary zinc	17
Base and precious metals	17
Ferroalloy	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Rubber processing	
emulsion crumb rubber	17
solution crumb rubber	17
Textiles	17

TABLE 3.11. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF CHROMIUM

Source	References
Whole sugar cane burning	18
Sugar cane leaf track burning	18
Volcanoes - aircraft sampling	14
Volcanic dust flux	1
Volcanic gas flux	1
Soils	1
Agricultural open burning	19
Steelmaking furnace dust disposal*	
Open hearth	9
Electric	9
Basic oxygen	9
Nonferrous slags*	
Primary copper - reverb	13
- electric	13
Primary Lead - blast furnace	13
fresh fuming	13
old fuming	13
Primary magnesium	13
Secondary copper	13
Secondary lead	13
Secondary aluminum	13
Coal, ash	2
Continental dust flux	1
Secondary zinc - sweat furnace dust	20
Foundry dust	20
Paved roads	24

*Possible wind-blown dust source.

TABLE 3.12. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF POM

Source	References
Whole sugar cane burning	18
Sugar cane leaf trash burning	18
Landscape refuse burning	18
Wood preserving wastewater[B] (closed steaming using penta)	25
Residues in lagoons, holding ponds and tanks	25
Open burning - municipal refuse	26
- landscape refuse	26
- automobile components	26
Volcanoes (ash)	27
Thermal geysers	27
Forest fires (pine needles)	
backing fires	28
heading fires	28
flaming heading fires	28
smoldering heading fires	28
Forest fires	28
Oak charcoal briquettes	29
Herbicide (Carbolineum)	30
Domestic wood smoke	
whole smoke	31
vapor phase only	31
wood stove	29
Open burning	
grass and leaves	32
grass clippings, leaves and branches	33
floor mats and auto seats	33
automobile tires	33
automobile bodies	33
Rubber tire dust	34
Gold mine dust	35
Road dust*	36
Open burning	37
Agricultural burning	37
Natural fires - forest	37
- urban	37
Coal refuse piles	37
Coal refine piles, outcrops and abandoned mines	19
Prescribed burning	19
Agricultural open burning	19
Open burning - wood waste	19
- rail cars	19
Gas-fired air conditioning	19
Swimming pool heating	19

* From road covered with bitumen; West Germany.

TABLE 3.13. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF DIOXINS

Source	References
Burning of treated wood	38
Burning of brush and trees coated with 2,3,7,8-TCDD	38
Pentachlorophenol (penta); used as wood preservative	38
	38
Wood preservative evaporation ponds	38
Soil concentrations	39
Dust concentrations	39
Fly ash	40
Residential wood combustion	
High air restriction (air tight)	41
Low air restriction	41

TABLE 3.14. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF FORMALDEHYDE

Source	References
Open burning	
Municipal refuse	26
Landscape refuse	26
Automobile components	26
Vegetation	42
Forest fires	42

TABLE 3.15. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF MANGANESE

Source	Refererences
Slags (possible windblown dust source)	
BOF	8
Nonferrous	
Primary Copper-reverb.	13
Primary Copper-electric	13
Primary Lead - blast furn.	13
Primary Lead - fresh fuming	13
Primary Lead - old fuming	13
Primary tin -	13
Secondary Copper	13
Secondary Lead	13
Natural brines - subsurface	2
Volcanoes (Mt. St. Helen)	14
Coal ash	2
Continental dust flux	1
Volcanic dust flux	1
Volcanic gas flux	1
Soil concentration	1
Furnace dusts*- Open hearth	9
Electric	9
Basic Oxygen	9
Primary Zinc* - roaster flue dust disposal	20
Secondary Zinc* - sweat furnace dust disposal	20
Foundry dust disposal*	20
Unpaved roads	21
Paved roads	24
Agricultural Tilling	21

* Residues collected by air pollution control equipment and then dumped. Possible wind-blown dust source.

TABLE 3.16. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF MERCURY

Source	References
Coal Ash	2
Nonferrous slags*	
Primary Copper - reverb.	13
Primary Copper - electric	13
Primary Magnesium	13
Volcanoes (Mt. St. Helens)	
In plume	43
Output from volcano	43
In Pumice	43
Coal refuse piles, out crops, and abandoned mines	19
Nonagricultural pesticide usage	44
Degassing (soils)	44
Sewage disposal	44
Fungicides and mildewcides	45
Mercury ore deposits	45
Geothermal steam fields	45
Total rock weathering and vaporization	45
Burning dumpsite - in plume	46
Mercury mines	47
Base mines	47
Gold mines	47
Porphyry copper mine	47
Volcanic and geothermal	
Iceland	
Fumarolic	48
Magmatic	48
Nonthermal	48
Hawaii	
Fumarolic	48
Magmatic	48
Nonthermal	48
Hawaii - during eruption	48
Hawaii - Volcanoes National Park	48
Dump sites and sludge ponds; Hg-cell process for chlorine and caustic	50
Continental dust flux	1
Volcanic dust flux	1
Volcanic gas flux	1
Soil concentration	1
Volcanoes	
Iceland	
Thermal areas	51
Nonthermal areas	51
Hawaii	
Thermal areas	51
Nonthermal areas	51
Antarctic	
General	51
Primary Zinc - roaster flue dust disposal*	20

*Possible wind-blown dust source.

TABLE 3.17. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF METHYL CHLORIDE

Source	References
Volcanoes[A]	52
Ocean[B]	23
Wastewater treatment facilities	
Petroleum refineries	17
Textiles	17
Wood processing	17

A Sample taken inside Mauna Loa Observatory which is located 5 miles from Mauna Loa Volcano in Hawaii. Methyl chloride was sampled because of its reported (source unknown) association with volcanic eruptions.

B Methyl chloride is reported (Ref. 23) to be primarily natural in origin with the oceans as a major source

TABLE 3.18. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF METHYL CHLOROFORM

Source	References
Wastewater treatment facilities	
Industrial laundries	17
Linen laundries	17
Power laundries	17
Alkaline mining	17
Mining preparation	17
Electric arc furnace (wet)	17
Hot forming - primary	17
Hot forming - section	17
Sulfuric acid pickling	17
Hydrochloric acid pickling	17
Cold rolling	17
Hot coating	17
Combination acid pickling	17
Hydride scale removal	17
Continuous alkaline	17
Leather tanning and finishing	17
Steel coil coating	17
Galvanized coil coating	17
Aluminum coil coating	17
Iron and steel foundries	17
Aluminum foundries	17
Zinc casting	17
Copper casting	17
Tall oil resins, fatty acids, & pitch	17
Primary columbium and tantalum	17
Secondary silver	17
Primary tungsten	17
Ferroalloy	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Utility boilers	17
Textiles	17

TABLE 3.19. NONINDUSTRIAL SOURCES OF METHYLENE CHLORIDE

Source	References
Forest fires - broadcast burn	3
Wastewater treatment facilities	
Industrial laundries	17
Linen laundries	17
Power laundries	17
Coin-operated laundries	17
Car washes	17
Alkaline mining	17
Mining preparation	17
Hot forming-primary	17
Hot forming-flat	17
Sulfuric acid pickling	17
Hydrochloric acid pickling	17
Hot coating	17
Iron and steel foundries	17
Aluminum foundries	17
Zinc casting	17
Magnesium casting	17
Wood rosin, turpentine, and pine oil	17
Tall oil resins, fatty acids, and pitch	17
Pharmaceutical mfg.	17
Primary aluminum	17
Secondary aluminum	17
Primary columbium and tantalum	17
Primary copper	17
Secondary copper	17
Primary lead	17
Secondary silver	17
Primary zinc	17
Base & precious metals mining & dressing	17
Ferroalloy	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Rubber processing	
Emulsion crumb	17
Solution crumb	17
Utility boilers	17
Textiles	17
Wood processing	17

TABLE 3.20. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF NICKEL

Source	References
Whole sugar cane burning	18
Sugar cane leaf trash burning	18
Coal ash	2
Volcanoes - fumarolic gases	2
Continental dust flux	1
Volcanic dust flux	1
Volcanic gas flux	1
Soil concentration	1
City street contamination	
Commercial	1
Residential	1
Industrial	1
Open burning - agricultural	19
Steel furnace dust disposal*	
Open hearth	9
Electric	9
BOF	9
Foundry dust disposal	20
Unpaved roads	21
Agricultural tilling	21

* Dust collected by air pollution control equipment and dumped. Possible wind-blown dust source.

TABLE 3.21. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF PERCHLOROETHYLENE EMISSIONS

Source	References
Wastewater treatment facilities	
Coin operated laundries	17
Chlor-alkali diaphragm cell	17
Sintering	17
Basic oxygen furnace (wet, open)	17
Vacuum degassing	17
Hot forming - primary	17
Hot forming - section	17
Sulfuric acid pickling	17
Hydrochloric acid pickling	17
Cold rolling	17
Hot coating	17
Combination acid pickling	17
Kolene scale removal	17
Continuous alkaline	17
Leather tanning and finishing	17
Iron & steel foundries	17
Aluminum foundries	17
Zinc casting	17
Copper casting	17
Porcelain enameling on copper	17
Pharmaceutical manufacturing	17
Secondary aluminum	17
Primary columbium & tantalum	17
Primary copper	17
Secondary copper	17
Secondary lead	17
Secondary silver	17
Primary tungsten	17
Primary zinc	17
Base & precious metals mining & dressing	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Utility boilers	17
Textiles	17

TABLE 3.22. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF PHENOL EMISSIONS

Source	References
Wood preserving	25
Residue in lagoons, holding ponds, and tanks	
Evaporation ponds	16
Open steaming - pond evaporation	16
Closed steaming - pond evaporation	16
Boultonizing - pond evaporation	16

TABLE 3.23. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF POLYCHLORINATED BIPHENYL (PCB) EMISSIONS

Source	References
Landfill[A]	53
Landfills - municipal	
Durham, NC (new)	54
Durham, NC (old)	54
Raleigh, NC (old)	54
Goldsboro, NC (demolition site)	54
Spill sites - NC	54
Great Lakes study	
Landfill gases	55
Impact on Lake Michigan due to rainout	55

[A] Landfill used for the disposal of capacitors and other PCB waste.

TABLE 3.24. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF RADIONUCLIDE EMISSIONS

Source	References
Coal ash	2
Volcanoes - Mt. St. Helens	
Natural brines - Rb	2
Leaking drums of plutonium oil	56
(air samples - Be^{7}, Am^{241})	56
Soil concentrations(U^{238}, Th^{232})	57
Tailings & Spoils Piles	
Uranium mining	
Overburden piles	57
Refilled pits	57
Sub-ore piles	57
Iron ore production	
Tailings pile	57
Geothermal sources (Ra^{222})	
Geysers	57
Brines	57
Decay of primodal radionuclides	2
Exhalation of radionuclide gases from soil	2
Weathering of surface rocks	2
Other exhalations (mining, volcanoes)	2
Produced by cosmic rays	2
Oceans	2

TABLE 3.25. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF TOLUENE EMISSIONS

Source	References
Forest fires - loblolly pine	15
Forest fires - broadcast burn	15
Wood preserving - evaporation from ponds -	16
Open steaming	16
Closed steaming	16
Wastewater treatment facilities	
Industrial laundries	17
Linen laundries	17
Power laundries	17
Coin operated laundries	17
Mining preparation	17
Byproduct coking	17
Sintering	17
Blast furnace - iron	17
Basic oxygen furnace (wet open)	17
Basic oxygen furnace (wet suppressed)	17
Open hearth furnace	17
Vacuum degassing	17
Hot forming	17
Pipe and tube	17
Sulfuric acid pickling	17
Hydrochloric acid pickling	17
Cold rolling	17
Hot coating	17
Combination acid pickling	17
Kolene scale removal	17
Continuous alkaline	17
Leather tanning and finishing	17
Aluminum foundries	17
Zinc casting	17
Magnesium casting	17
Wood rosin, turpentine, and pine oil	17
Tall oil resin, fatty acids, and pitch	17
Pharmaceutical manufacturing	17
Primary aluminum	17
Primary copper	17
Secondary copper	17
Secondary silver	17
Primary tungsten	17
Primary zinc	17
Base & precious metals mining & dressing	17
Ferroalloy	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Rubber processing	17
Textiles	17
Timber products	17

TABLE 3.26. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF TRICHLOROETHYLENE

Source	References
Wastewater treatment facilities	
Industrial laundries	17
Linen laundries	17
Power laundries	17
Car washes	17
Mining preparation	17
Copper sulfate	17
Sintering	17
Hot forming	17
Sulfuric acid pickling	17
Hydrochloric acid pickling	17
Combination acid pickling	17
Cold rolling	17
Hot coating	17
Hydride scale removal	17
Leather tanning and finishing	17
Steel coil coating	17
Galvanized coil coating	17
Aluminum coil coating	17
Iron & steel foundries	17
Zinc casting	17
Secondary aluminum	17
Primary columbium and tantalum	17
Primary copper	17
Secondary copper	17
Secondary lead	17
Secondary silver	17
Primary tungsten	17
Primary zinc	17
Paint formulation	17
Ink formulation	17
Petroleum refining	17
Pulp, paper, and paperboard	17
Rubber processing (solution crumb)	17
Textiles	17

TABLE 3.27. LITERATURE CITATIONS - NONINDUSTRIAL SOURCES OF XYLENE EMISSIONS

Source	References
Forest fires - loblolly pine	15
- broadcast burn	3

4.0 REFERENCES

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APPENDIX

INDUSTRIAL, COMBUSTION, AND INCINERATION SOURCES OF POTENTIALLY TOXIC SUBSTANCE EMISSIONS

NOTES TO TABLE A-1

1) The first entry under the "Emission Source" column is entitled "Production." Production refers to the production of the substances listed in the other columns. A circle (dot) in the columns means that the substance is emitted during the production of that substance.

   Some of the substances do not have the dots associated with production.

   a) Cadmium - Cadmium is not directly produced in the U.S. It is recovered as a by-product of zinc, zinc-lead, zinc-copper, and complex ores.

   b) Coke oven emissions (POM), Dioxin, and Radionuclides - These substances occur as by-products of combustion.

   c) Polychlorinated Biphenyls - PCB's are no longer produced in the U.S.

2) The other entries under the "Emission Source" column refer to the production of each substance or item listed. For example, "acetal resins" means acetal resin production.

3) The entries under the "Emission Source" column that do not correspond to a substance (e.g., aircraft engines, iron foundries, etc.) mean that the substance is emitted from this source during its operation.

Table A-1. Industrial Emission Sources of Potentially Toxic Substances

EMISSION SOURCE	POTENTIALLY TOXIC SUBSTANCE																																												
	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Production	●	●	●	●	●	●	●	●	●		●	●	●	●	●		●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●		●	●	●	●	●
ABS/SAN resins			●																																										
Acetalaldehyde																													●																
Acetal resins																								●																					
Acetic acid	●																																												
Acetone from cumene																																				●									
Acetylenic chemicals																								●																					
Acrylamide			●																																										
Acrylic acid	●	●																						●																					
Acrylic esters																								●																					
Acrylic & monoacrylic fibers & resins			●																																										
Acrylonitrile	●			●			●																																		●				
Adhesives																						●																							
Adiponitrile			●				●							●																															
Adipic acid																																													
Alachlor																										●																			
Alkyd resins																																													
Alkylbenzenes & Dialkyl benzenes							●																																						
Alloy steel																																●													

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Ammonium methane-arsonate					•																																								
Aniline							•																										•			•									
Antioxidants																	•																												
Arsanilic acid					•																																								
Arsenic trioxide					•																																								
Asbestos mining						•									•																														
Asbestos fibers preparation						•																																							
Asbestos pipes						•																																							
Asbestos products						•									•																														
Asphalt paving: dryer drum & hot mix process																•																													
Asphalt plants							•																	•																					
Asphalt roofing																•																													
Atrazine											•		•											•																					
Automobile engines																																													
Automobile tires										•																																			
Battery manufacture																												•																	

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Benzaldehyde																																										•			
Benzene																																										•			
Benzene-m-disulfonic acid							•																																						
Benzonitrile							•																																						
Benzoic acid																																									•				
Benzosulfonic acid							•																																						
Benzoyl benzoic acid .							•																																						
Benzyl alcohol								•																																					
Benzyl chloride																																									•				
Beryllium copper alloys									•																																				
Beryllium fabrication									•																																				
Beryllium oxide ceramics									•																																				
Biphenol A																																				•									
BHT																	•																												
Bromacil																																					•								
Butanediol																								•																					
2-butoxyethanol																							•																						
Butyl benzyl phthalate								•																																					
Butylene glycol	•																																												
Cacodylic acid					•																																								

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Cadmium-barium stabilizers										•																																			
Cadmium-nickel batteries										•																																			
Cadmium pigments										•																																			
Calcium acid methane-arsonate					•																																								
Calcium arsenate					•																																								
Caprolactum																																				•									
Captan																										•																			
Carbon black					•				•	•					•	•											•	•				•													
Carbon tetrachloride													•																		•					•									
Carpet backing adhesive																																											•		
Cement									•	•					•												•	•			•	•													
Ceramic paste in electrical circuit systems																						•																							
Charcoal manufacture																								•																					
Chelating agents																								•																					
Chlor-alkali																												•																	
Chlorendic anhydride																										•																			
Chlorobenzene							•											•				•																							
Chloroform											•																		•		•						•								
Chlorophenol											•																									•									

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	POTENTIALLY TOXIC SUBSTANCE																																												
	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Chloroprene/neoprene																																									•				
Chlorotrifluoromethane													•																																
Chlorosulfonic acid												•																																	
Chromates															•																														
Chromic acid															•																														
Chromium oxide															•																														
Chromium compounds															•																														
Coal preheater - coking																•																													
Coffee roasting	•	•																																											
Coke quenching							•									•	•																												
Coke oven doors																•																													
Coke ovens																	•										•	•								•									
Combustion																																													
- boiler																				•														•											
- coal					•					•					•	•								•			•	•				•								•					
- gas																•				•				•				•																	
- incomplete																								•																					
- motor fuel																																		•											
- oil					•				•							•								•			•	•				•								•					
- rocket fuel																																		•											
- wood																•																													

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

POTENTIALLY TOXIC SUBSTANCE

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium
Cooling towers															•
Copper mining										•					
Copper smelting - primary & secondary					•					•					
Corrosion inhibitor															
Cotton gins					•										
Cresols															
Cresylic acid															
Cresyldiphenyl phosphate															
Cresylic diphenol phosphate															
Crotonaldehyde	•														
Cumene							•								
Cumene sulfonate-ammonium salt							•								
Cumene sulfonic acid							•								
Cutting oils															
Cyclohexane							•								
Cyclohexanone/cyclohexanol/cyclohexylamine							•								
Detergent alkylates							•								
Dichloroaniline												•			

EMISSION SOURCE	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform
Cooling towers															
Copper mining													•		
Copper smelting - primary & secondary													•		
Corrosion inhibitor															
Cotton gins															
Cresols															
Cresylic acid		•													
Cresyldiphenyl phosphate															
Cresylic diphenol phosphate		•													
Crotonaldehyde															
Cumene															
Cumene sulfonate-ammonium salt															
Cumene sulfonic acid															
Cutting oils															•
Cyclohexane															
Cyclohexanone/cyclohexanol/cyclohexylamine															
Detergent alkylates															
Dichloroaniline															

EMISSION SOURCE	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Cooling towers															
Copper mining															
Copper smelting - primary & secondary															
Corrosion inhibitor				•											
Cotton gins															
Cresols						•					•				
Cresylic acid															
Cresyldiphenyl phosphate						•									
Cresylic diphenol phosphate															
Crotonaldehyde															
Cumene															
Cumene sulfonate-ammonium salt															
Cumene sulfonic acid															
Cutting oils															
Cyclohexane															
Cyclohexanone/cyclohexanol/cyclohexylamine		•				•									
Detergent alkylates															
Dichloroaniline															

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	POTENTIALLY TOXIC SUBSTANCE																																												
	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Dichlorobenzene							●					●					●																												
Dichlorodifluoromethane											●																																		
Dichlorotetrafluoroethane																																			●										
Dicofol												●																																	
Diethylene glycol																							●																						
Dimethoate																																									●				
Dimethyl acetamide																			●																										
Dimethyl formamide																			●																										
Dimethyl hydrazine																			●																										
Dimethyl terephthalate																																													●
m-,p-,Diisopropyl benzene							●																																						
Diphenyl							●																																						
Diphenyl oxide												●																																	
Dipropylene glycol																																							●						
Disinfectants & cleaning compounds																	●					●																							
Disodium methylarsonate					●																																								
DMT & TPA	●																																												
Dodecylphenol																																				●									
Drain cleaner																														●															
Drycells																												●																	

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Dry cleaning											•																																	
Dry storage battery products																										•																			
DSMA					•																																							
Ethylene amines																						•							•															
Elastomers																								•																				
Electroplating										•																					•													
Epichlorohydrin elastomers																					•																							
Epoxy resins																					•																							
Ethanol	•																																										
Ethanol amines																							•																					
Ethoxyethanol																						•																						
Ethoxylated mixed linear alcohols																						•																						
Ethoxylated nonylphenol																						•																						
Ethoxylated octyphenol																						•																						
Ethylbenzene							•																																				
Ethylchloride																					•																							
Ethylene amines																					•																							
Ethylene diamine																					•																							
Ethylene dichloride																						•																						

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Ethylene glycol anti-freeze																							●																						
Ethylene glycol polyester																							●																						
Ethylene propylene rubber																																									●				
Ethylene propylene terpolymer																																									●				
Explosives																								●																					
Fabric cleaner																																													
Feldspar mining & processing									●																																				
Ferroalloy & Ferro Mn production																●											●																		
SiMn production																											●																		
Fertilizers																								●																					
Fish meal processing																																		●											
Flame retardants & flame retardant resins																									●																				
Floor waxes											●																																		
Fluorocarbon gases											●																																		
Fluorocarbon resins													●																																
Fumaric acid							●																																						

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

POTENTIALLY TOXIC SUBSTANCE

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium
Fungicides															
Gas-fired appliances															
Gasoline distribution & handling							●								
Gasoline refining							●								
Gasoline backblending															
Glass industry					●										
Glutaraldehyde		●													
Glycerin (synthetic)		●													
Glycerol		●		●											
Glycidol ethers															
Glycol ethers															
Glyoxal	●														
Grain fumigants															
Herbicides															
Hexachlorocylopentadiene															
Hexamethylenetetramine															
Incinerators															
Instrument manufacture															
Ion exchange resins															
Iron & Steel										●					

EMISSION SOURCE	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform
Fungicides													●		
Gas-fired appliances	●														
Gasoline distribution & handling															
Gasoline refining															
Gasoline backblending															
Glass industry															
Glutaraldehyde															
Glycerin (synthetic)						●									
Glycerol						●									
Glycidol ethers						●									
Glycol ethers								●							
Glyoxal															
Grain fumigants							●								
Herbicides													●		
Hexachlorocylopentadiene															
Hexamethylenetetramine									●						
Incinerators					●										
Instrument manufacture													●		
Ion exchange resins						●									
Iron & Steel															

EMISSION SOURCE	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Fungicides															
Gas-fired appliances															
Gasoline distribution & handling											●	●			●
Gasoline refining															
Gasoline backblending															
Glass industry															
Glutaraldehyde															
Glycerin (synthetic)															
Glycerol															
Glycidol ethers															
Glycol ethers									●						
Glyoxal															
Grain fumigants															
Herbicides															
Hexachlorocylopentadiene															
Hexamethylenetetramine															
Incinerators															
Instrument manufacture															
Ion exchange resins															
Iron & Steel															

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Iron foundries					●				●																		●																		
mold & core decomposition	●	●					●																	●													●								●
Isocyanates																																													
Isophthalic acid																																													●
Kraft recovery furnaces															●																														
Lamp manufacture																												●																	
Lauryl dimethyloxide																			●																										
Lead arsenate					●																																								
Lead mining										●																		●																	
Lead scavenger in gasoline																						●																							
Lead smelting					●					●																		●																	
Lime processing																												●																	
Linear alkylbenzene							●																																						
Malathion																																													
Maleic acid																																									●				
Maleic anhydride							●																			●																			
Maleic hydrazide																								●		●																			

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Manganese chemical preparation																																													
Manganese dioxide																											•																		
Manganese sulfate																																													
Melamine-formaldehyde resins																								•																					
Mercury compounds																												•																	
Mercury mining & processing																												•																	
Methane arsenic acid					•																																								
Methionine & methionine hydroxy analog		•																																											
Methyl chloride											•		•																		•														
Methyl chloroform																						•																			•	•	•		
Methyl parathion																													•																•
Methylene chloride											•		•									•	•						•								•								
Mica mining & processing									•																																				
Monosodium glutamate			•																																										
Morpholine production																																		•											
Moth proofing agent for textiles										•								•										•																	
MSMA					•																								•																

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

POTENTIALLY TOXIC SUBSTANCE

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride
Municipal incineration									•	•						•						
Nickel sulfate																						
Nickel compounds-other																						
Nitrile elastomer			•																			
Nitroanilene																						
Nitrobenzene							•															
Nitrochlorobenzene												•										
p-Nitrophenol																						
Nonferrous alloys					•					•												
Nonylphenol																						
Nylon			•				•															
Octylphenol																						
Optical brightener manufacture																						
Ore flotation																	•					
Paints & lacquers											•											•
Paint & varnish remover																						

EMISSION SOURCE	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Municipal incineration						•				•													
Nickel sulfate										•													
Nickel compounds-other										•													
Nitrile elastomer																							
Nitroanilene											•												
Nitrobenzene																							
Nitrochlorobenzene																							
p-Nitrophenol														•									
Nonferrous alloys					•					•													
Nonylphenol															•								
Nylon																							
Octylphenol														•									
Optical brightener manufacture												•											
Ore flotation																							
Paints & lacquers						•																	
Paint & varnish remover									•														

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorohydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Paper products industry																								•				•																	
Paraformaldehyde																								•																					
Penicillin G-potassium & procaine																								•																					
Pentachlorophenol & sodium salts.																																				•									
Pentaerythritol	•																							•																					
Peracetic acid	•																																												
Perchloroethylene (PCE)																						•																							
Permanent magnet alloys																																	•												
Pesticides											•						•		•						•									•											•
intermediates																		•																											
pyrethroid																	•																												
Petroleum refineries																•								•				•																	
Pharmaceutical manufacture																												•																	
Phenol	•						•																	•																	•				
Phenol/acetone	•				•		•																	•			•																		
Phenol formaldehyde resins																								•																					
Phenolic resins																																				•									

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	POTENTIALLY TOXIC SUBSTANCE																																												
	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Phenyl mercurials (moth proofing for textiles)																												•								•									
Phosphate rock mining & processing					•																																								
Phosphoric acid					•																																								
Phthalic anhydride																								•		•																			•
α-Picoline			•																																										
Pig iron					•																						•																		
Pigments															•																														
Plastics processing																															•														
Polishes & waxes											•																							•											
Polyacetal resins																								•																					
Polyacrylonitrile			•																																										
Polycarbonates																																					•								
Polycarbonate resins																																				•	•								
Polychloroprene														•																											•				
Polyester polyols																																							•						
Polyester resins (unsaturated)																										•																			
Polymeric isocyanates																																					•								

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Textiles:																																													
coatings																								•																				•	
crease resistants																								•						•															
curing																								•																					
dry cleaning											•																								•										
dye accelerants												•																							•	•						•			
dye carriers												•																							•	•									
dye correctives																		•																											
dyes															•									•																					
heat setting																								•																					
pressure drying knits																								•											•										
resin finishing -																																													
tenter frames																																				•						•			
curing ovens																								•												•									
scouring											•																															•			
shrinkage control																																			•										
Toluene diisocyanate																																					•				•				
Toluene sulfonic acid																																									•				
1,2,4-Trichlorobenzene							•																																						
Trichloroethylene											•											•																							

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

POTENTIALLY TOXIC SUBSTANCE

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroetnylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Polymethylene polyphenyl isocyanate																								●													●								
Polysulfide compounds																						●																							
Polyvinyl chloride	●													●								●													●								●	●	
Polyvinylvinylidenechloride																																										●	●	
Potassium permanganate																										●																		
Potassium hydroxide																											●																	
Power plants																								●																					
Printing inks											●																																		
Propylene oxide	●																																												
Propyl glycol																																						●						
Pyridines	●																																												
Quaternary ammonium compounds								●																																					
Refractories															●																														
Refractory brick production															●																														
Ronnel																																													
Rubber cement											●																																		
Rubber chemicals																																	●											
Rubber industry; chemical accelerators																			●																										

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	POTENTIALLY TOXIC SUBSTANCE																																												
	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Salicylates (excluding aspirin)																																				•									
Salicylic acid																																				•									
Sarans			•																																										
SBR (from carbon black)																•																													
Sewage sludge incineration					•				•	•																	•	•				•													
Silicon manganese production																											•																		
Silvex																																				•									
Sodium arsenate					•																																								
Solvents:																																													
adhesives							•																																						
cellulose ether																																									•	•			•
degreaser							•				•	•																					•												
oil, wax & fat extracts											•																			•					•							•			•
ink																																													
lubricants																																									•				
paints & thinners							•																																			•			
pesticides												•	•																																
petroleum industry																																	•												

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Solvents:																																													
pharmaceuticals													●																												●				
sealants																																									●				
textiles							●																																						
urethane coating																														●															●
wire enamel																	●																												
Space deordorant																		●																											
Stainless steel																																●													
Stains											●																																		
Steel					●					●																	●																		
Styrene																																													
Sulfite pulp mills															●																														
Super alloys																																●													
Surface active agents																																													
Surfactants																					●																								
Surfactant glycols																																							●						
Terephthalic acid																																													●
Tetraethyl/tetramethyl lead																													●																
Tetrahydrofuran																								●																					

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	POTENTIALLY TOXIC SUBSTANCE																																												
	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorohydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Trichlorophenol																				●																●									
2,4,5-Trichlorophenoxy acetic acid																				●																									
Tricresyl phosphate																	●																												
Triethylene glycol																							●																						
Trifluralin													●																																
Trimethylol propane																								●																					
Urea formaldehyde resins & concentrates																								●																					
Urethane																												●																	
Urethane polyols																																							●						
Vat dyes																												●																	
Vinyl acetate	●																							●					●																
Vinyl chloride monomer																						●																							
Vinylidene chloride (VDCM)																						●																							
Vinyl toluene																																									●				
Waste Incineration					●				●	●						●											●						●					●							
Water Treatment Resins																					●																								
Welding rod production																											●																		
Wet strength resins for paper																					●																								

Table A-1. Industrial Emission Sources of Potentially Toxic Substances (Cont'd)

EMISSION SOURCE	Acetaldehyde	Acrolein	Acrylonitrile	Allyl Chloride	Arsenic	Asbestos	Benzene	Benzyl Chloride	Beryllium	Cadmium	Carbon Tetrachloride	Chlorobenzene	Chloroform	Chloroprene	Chromium	POM	o-,m-,p-Cresol	p-Dichlorobenzene	Dimethyl Nitrosamine	Dioxin	Epichlorochydrin	Ethylene Dichloride	Ethylene Oxide	Formaldehyde	Hexachlorocyclopentadiene	Maleic Anhydride	Manganese	Mercury	Methyl Chloride	Methyl Chloroform	Methylene Chloride	Nickel	Nitrobenzene	Nitrosomorpholine	Perchloroethylene	Phenol	Phosgene	Polychlorinated Biphenyls	Propylene Oxide	Radionuclides	Toluene	Trichloroethylene	Vinyl Chloride	Vinylidene Chloride	o-,m-,p-Xylene
Wood preservatives					●																																								
Wood products industry																								●																					
Xylenes																																										●			
Xylene sulfonate Sodium, Potassium & Ammonium Salt																																													●
Xylidenes																																													●
Zinc mining										●																		●																	
Zinc smelting					●					●																		●																	

Table A-2. Industrial Sources of Acetaldehyde Emissions

Production of:
- Acetaldehyde
- Acetic acid
- Acrylic acid
- Acrylonitrile
- 1,3- Butylene glycol
- Crotonaldehyde
- DMT & TPA
- Ethanol
- Glyoxal
- Pentaerythritol
- Peracetic acid
- Phenol
- Phenol/acetone
- Polyvinyl chloride
- Propylene oxide
- Pyridines
- Vinyl acetate

Coffee roasting

Iron foundries (mold & core decomposition)

Table A-3. Industrial Sources of Acrolein Emissions

Production of:
- Acrolein
- Acrylic acid
- Glutaraldehyde
- Glycerin (synthetic)
- Glycerol
- Methionine & methionine hydroxy analog

Coffee roasting

Iron foundries (mold & core decomposition)

Table A-4. Industrial Sources of Acrylonitrile Emissions

Production of:
- Acrylamide
- Acrylic & modacrylic resins and fibers
- Acrylonitrile
- Acrylonitrile-butadiene-styrene resins (ABS/SAN resins)
- Adiponitrile
- Monosodium glutamate
- Nitrile elastomer
- Nylon
- - Picoline
- Polyacrylonitrile
- Sarans

Table A-5. Industrial Sources of Allyl Chloride Emissions

Production of:
- Acrylonitrile
- Allyl chloride
- Epichlorohydrin
- Glycerol

Table A-6. Industrial Sources of Arsenic Emissions

Production of:
- Ammonium methanearsonate
- Arsanilic acid
- Arsenic trioxide
- Cacodylic acid
- Calcium acid methanearsonate
- Calcium arsenate
- Carbon black
- Disodium methylarsonate
- DSMA
- Lead arsenate
- Methane arsenic acid
- MSMA
- Phenol/acetone from cumene
- Phosphoric acid
- Sodium arsenite
- Wood preservatives

Copper smelting - primary
Combustion - coal, oil
Cotton gins
Glass industry (including opal and lead glass and flint glass)
Iron foundries
Lead smelting - primary and secondary
Nonferrous alloys
Phosphate rock mining and processing
Pig iron
Sewage sluge incineration
Steel - primary and secondary
Waste incineration
Zinc smelting - primary

Table A-7: Industrial Sources of Asbestos Emissions

Asbestos mining
Asbestos pipe production
Asbestos products production and use (textiles, brake linings, shingles and siding)
Asbestos fibers production - carding, combing, preparation, spinning and weaving
Kraft recovery furnace
Sulfite pulp mill

Table A-8. Industrial Sources of Benzene Emissions

Production of:
- Acrylonitrile
- Adiponitrile
- Alkylbenzyenes and dialkylbenzenes
- Aniline
- Benzene
- Benzene-m-disulfonic acid
- Benzonitrile
- Benzosulforic acid
- α- Benzoylbenzoic acid
- Chlorobenzene
- Cumene
- Cumene sulfonate - ammonium salt
- Cumene sulfonic acid
- Cyclohexane
- Detergent alkylates
- Dichlorobenzenes
- m- & p- Diisopropylbenzene
- Diphenyl
- Ethylbenzene
- Fumaric acid
- Linear alkylbenzene
- Maleic anhydride
- Nitrobenzene
- Nylon 6
- Phenol
- Phenol/acetone
- Styrene
- 1,2,4-Trichlorobenzene

Asphalt plants
Coke ovens - pushing, doors, quenching, byproduct plant
Gasoline distribution and handling
Gasoline refining
Iron foundries (mold and core decomposition)
Solvent evaporation - degreasers
Solvent users - paints, adhesives, thinners, textiles

Table A-9. Industrial Sources of Benzyl Chloride Emissions

Production of:
- Benzyl alcohol
- Benzyl chloride
- Butyl benzyl phthalate
- Quarternary ammonia compounds

Table A-10. Industrial Sources of Beryllium Emissions

Production of:
- Beryllium metal
- Be-Cu alloys
- Beryllium fabrication
- Beryllium oxide
- Carbon black
- Cement

Ceramics manufacturing
Coke ovens
Combustion - coal, diesel, oil
Feldspar mining and processing
Iron foundries
Mica mining and processing
Municipal incineration
Sewage sludge incineration
Waste incineration

Table A-11. Industrial Sources of Cadmium Emissions

Automobile tire use
Cadmium-barium stabilizer production and use
Cadmium-nickel battery production
Cadmium pigment production
Carbon black production
Cement production
Coke ovens
Combustion - coal, oil
Copper mining
Copper smelting - primary and secondary
Electroplating
Iron and steel production
Iron foundries
Lead mining
Lead smelting - primary
Moth proofing agents for textiles
Municipal incineration
Nickel - primary
Nonferrous alloy production
Sewage sludge incineration
Steel - primary and secondary
Waste incineration
Zinc mining
Zinc smelting - primary and secondary

Table A-12. Industrial Sources of Carbon Tetrachloride Emissions

Production of:
- Atrazine
- Carbon tetrachloride
- Chloroform
- Chlorophenol
- Chlorotirfluoromethane
- Dichlorodifluoromethane
- Floor waxes
- Fluorocarbon gases
- Methyl chloride
- Methylene chloride
- Paints and lacquers
- Pesticides
- Printing inks
- Polishes for shoes and furniture
- Rubber cement
- Stains
- Trichloroethylene

Solvents - degreasing
Solvent use in oil, wax, and fat extracts
Textiles - scouring and dry cleaning

Table A-13. Industrial Sources of Chlorobenzene Emissions

Production of:
- Chlorobenzene
- Chlorosulfonic acid
- Dichlorobenzenes
- Dicofol
- Diphenyl oxide
- Nitrochlorobenzene

Solvents - degreasing
- pesticide

Textiles - dye accelerants
- dye carriers

Table A-14. Industrial Sources of Chloroform Emissions

Production of:
- Carbon tetrachloride
- Chloroform
- Fluorocarbons (chlorodifluoromethane)
- Fluorocarbon resins
- Methyl chloride
- Methylene chloride
- Solvents for pharmaceuticals
- Solvents for pesticides
- Trifluralin

Table A-15. Industrial Sources of Chloroprene

Production of:
- Adiponitrile
- Chloroprene
- Polychloroprene (neoprene)
- Polyvinyl chloride

Table A-16. Industrial Sources of Chromium Emissions

Production of:
- Asbestos products
- Carbon black
- Cement
- Chromates - Sodium chromate & dichromate
  Potassium bichromate & chromate
- Chromium - primary
- Chromic acid
- Chromium compounds - acetates, borides, halides, etc.
- Chromium oxide - inorganic pigment
- Refractories
- Refractory bricks

Asbestos mining
Combustion - coal, oil
Cooling towers - rust inhibitors
Iron foundries
Kraft recovery furnaces
Steel production
Sulfite pulp mills
Textile dyes

Table A-17. Industrial Sources of POM

Asphalt paving - dryer drum process
Asphalt paving - hot mix
Asphalt roofing
Carbon Black
Coal preheater - coking
Coke ovens
Coke oven doors
Coke quenching
Combustion - coal, wood, oil and gas
Ferroalloy furnaces
Gas-fired appliances
Incineration
Iron foundry - shakeout
Petroleum refining
SBR (from carbon black)

Table A-18. Industrial Sources of Cresol (o-, m-, p-cresol) Emissions

Production of:
- Antioxidants
- Cresols
- Cresylic acid
- Cresylic diphenol phosphate (CDP)
- Disinfectants/cleaning compounds
- 2,6 - ditert butyl-p-cresol (BHT)
- Pesticides
- Phenolic resins
- Pyrethroid pesticides
- Tricresyl phosphate (TCP)

Coke ovens
Coke quench tower
Ore flotation
Solvent-wire enamel

Table A-19. Industrial Sources of p-Dichlorobenzene Emissions

Production of:
- Chlorobenzene
- o- Dichlorobenzene
- p- Dichlorobenzene
- Pesticide intermediates
- Space deodorants

Degreasing
Moth control
Textiles - thermasol dye ranges

Table A-20. Industrial Sources of Dimethylamine (Dimethyl Nitrosamine) Emissions

Production of:
- Dimethyl acetamide
- Dimethylamines
- Dimethyl formamide
- Dimethyl hydrazine
- Lauryl dimethylamine oxide
- Pesticides
- Rubber industry chemical accelerators

Fish meal processing
Combustion - Rocket fuel, boiler, and motor fuels

Table A-21. Industrial Sources of Dioxin Emissions

Combustion - diesel, gasoline, wood, oil, coal
Incinerators
Pentachlorophenol production
Trichlorophenol production
2,4,5-trichlorophenoxy acetic acid (2,4,5-T) production
2,4,5-T application (weed control)
Wood preservation using pentachlorophenol

Table A-22. Industrial Sources of Epichlorohydrin Emissions

Production of:
- Epichlorohydrin
- Epichlorohydrin elastomers
- Epoxy resins
- Glycerin (synthetic)
- Glycerol
- Glycidol ethers
- Ion-exchange resins
- Surfactants
- Water treatment resins
- Wet-strength resins for paper

Table A-23. Industrial Sources of Ethylene Dichloride Emissions

Production of:
- Ceramic paste used in electronic circuit systems
- Chlorobenzene
- Ethylchloride
- Ethyleneamines
- Ethylene diamine
- Ethylene dichloride
- Methyl chloride
- Methyl chloroform
- Methylene chloride
- Perchloroethylene
- Polysulfide compounds (rubber)
- Polyvinyl chloride
- Trichloroethylene
- Vinyl chloride monomer
- Vinylidene chloride

Grain fumigants
Lead scavenger in gasoline

Table A-24. Industrial Sources of Ethylene Oxide Emissions

Production of:
- 2 - butoxyethanol
- Diethylene glycol
- Ethanolamines
- Ethoxyethanol
- Ethoxylated mixed linear alcohols
- Ethoxylated nonylphenol
- Ethoxylated octylphenol
- Ethylene glycol antifreeze
- Ethylene glycol polyester
- Ethylene Oxide
- Glycol ethers
- Surface active agents
- Triethylene glycol

Table A-25. Industrial Sources of Formaldehyde Emissions

Production of:
- Acetal resins
- Acetylenic chemicals
- Acrylic acid
- Acrylic esters
- Alachlor
- Alkyd resins
- Butanediol
- Chelating agents
- Dyes
- Elastomers
- Explosives
- Fertilizers
- Fibers
- Formaldehyde
- Hexamethylenetetramine
- Maleic anhydride
- Melamine-formaldehyde resins
- Paraformaldehyde
- Pencillin G - potassium & procaine
- Pentaerythritol
- Phenol
- Phenol/acetone from cumene
- Phenol-formaldehyde resins
- Phthalic anhydride
- Polyacetal resins
- Polymethylene polyphenyl isocyanate
- Pyridine
- Tetrahydrofuran
- Trimethylolpropane
- Urea-formaldehyde concentrates
- Urea-formaldehyde resins
- Vinyl acetate

Asphalt plants

Charcoal manufacture

Combustion - coal, gas, oil, incomplete

Incineration

Iron foundries - mold and core decomposition

Petroleum refining - alkyation
- catalytic cracking
- crude distillations
- vacuum distillations

Textiles - coatings (resins)
- crease resistance finishes
- drying, resinating, curing and heat setting of polyester
- dye correctives
- dying and curing of broad woven cotton
- setting and finishing of polyester and polyester cotton
- shrinkage control (urea - formaldehyde resins)

Wood products industry

Table A-26. Industrial Sources of Hexachlorocyclopentadiene Emissions

Production of:
- Flame retardant resins (chlorendic diesters)
- Flame retardants - Het-acid
  - Het-anhydrite
  - Dichlorane plus
- Hexachlorocyclopentadiene
- Pesticides - Chloradane
  - Endosulfane
  - Heptachlor

Table A-27. Industrial Sources of Maleic Anhydride Emissions

Production of:
- Alkyd resins
- Captan
- Chlorendic andydride
- Fumaric acid & agricultural pesticides
- Maleic acid
- Maleic anhydride
- Maleic hydrazide
- Phthalic anhydride
- Polyester resins - unsaturated

Table A-28. Industrial Sources of Manganese Emissions

Carbon black production
Cement production
Coke ovens
Combustion - coal, oil
Dry cell production
Ferroalloy and ferro-manganese production
Iron foundries
Lead smelting and refining - secondary
Manganese chemical preparation
Manganese dioxide production
Manganese production
Manganese sulfate production
Municipal incineration
Nonferrous alloy production
Pig iron production
Potassium permanganate production
Sewage sludge incineration
Silicon manganese production
Steel production
Waste incineration
Welding rod production

Table A-29. Industrial Sources of Mercury Emissions

Battery manufacture
Carbon black production
Cement production
Chlor-alkali
Coke ovens
Combustion - coal, fuel oil, gas
Copper mining & smelting
Fungicide production and use
Herbicide production and use
Instrument manufacture
Iron foundries
Lamp manufacture
Lead mining & smelting
Lime processing
Mercury compounds - halides, nitrates, oxides, etc.
Mining and processing of mercury
Municipal incineration
Paint production and formulation
Pesticides manufacture-nonagricultural
Petroleum refineries
Pharmaceutical manufacture
Phenyl mercurial production - mothproofing for textiles
Potassium hydroxide
Sewage sludge incineration
Urethane production
Vat dyes
Waste incineration
Zinc mining & smelting

Table A-30. Industrial Sources of Methyl Chloride Emissions

Production of:
- Acetaldehyde
- Cacodylic acid
- Carbon tetrachloride
- Chloroform
- DSMA
- Ethylene dichloride
- Methyl chloride
- Methylene chloride
- Methyl parathion
- MSMA
- Tetraethyl/tetramethyl lead
- Vinyl acetate

Table A-31. Industrial Sources of Methyl Chloroform Emissions

Prod uction of:
- Adhesives
- Drain cleaner
- Fabric cleaners
- Lubricant & coolant for cutting oils
- Methyl chloroform
- Methylene chloride
- Sealants (paints, etc.)
- Vinylidene chloride

Metal degreasing & cleaning
Solvent - urethane coating and others
Textiles - used as crease resistant finish

Table A-32. Industrial Sources of Methylene Chloride Emissions

Production of:
- Carbon tetrachloride from methane
- Chloroform
- Methyl chloride
- Methylene chloride

Metal degreasing
Paint and varnish remover
Plastics processing

Table A-33. Industrial Sources of Nickel Emissions

Production of:
- Alloy steel
- Carbon black
- Cement
- Coke
- Cyclohexanone/cyclohexanol & cyclohexylamine
- Ferroalloys
- Iron & steel
- Mining of nickel
- Nickel compounds - other (except sulfate)
- Nickel sulfate
- Nonferroalloys
- Stainless steel

Combustion - coal, diesel fuel, and oil
Electroplating
Iron foundries
Municipal incineration
Sewage sludge incineration
Waste incineration

Table A-34. Industrial Sources of Nitrobenzene Emissions

Production of:
- Aniline
- Nitroaniline
- Nitrobenzene

Chemical intermediates used for dichloranilines and dinitrobenzenes

Solvent - cellulose ether
- petroleum industry

Table A-35. Industrial Sources of Nitrosomorpholine Emissions

Corrosion inhibitor use
Morpholine production
Optical brightener manufacture
Polishes and waxes production
Rubber chemicals production

Table A-36. Industrial Sources of Perchloroethylene Emissions

Degreasing - solvent evaporation
Dichlorotetrafluoroethane production
Ethylene dichloride production
Methylene chloride production
Perchloroethylene production
Textiles - dry cleaning
- dye carrier in polyester
- pressure dying knits
- heat setting
- curing
- scouring

Table A-37. Industrial Sources of Phenol Emissions

Production of:
- Acetone from cumene
- Adipic acid
- Aniline
- Biphenol A
- Caprolactum
- Carbon black
- Chlorophenol
- Cresols
- Cresyldiphenyl phosphate
- Cyclohexanone/cyclohexanol & cyclohexylamine
- Dodecylphenol
- p- nitrophenol
- Nonylphenol
- Octylphenol
- Pentachlorophenol (PCP) & sodium salts
- Phenol
- Phenolic resins
- Phenol mercuricals - moth proofing agents
- Polycarbonate resins
- Polyvinyl chloride
- Salicylates, excluding aspirin
- Salicylic acid
- Silvex
- Trichlorophenols

Coke oven door leaks
Iron foundries - mold & core decomposition
Textiles - dye accelerants
- dye carrier
- resin finishing - tenter frames
- resin finishing curing ovens

Table A-38. Industrial Sources of Phosgene Emissions

Production of:
- Bromacil
- Chloroform (possible secondary pollutant due to oxidation of chloroform in sunlight)
- Isocyanates
- Methylene chloride (possibly due to exposure of methylene chloride to hot surfaces or open flames)
- Phosgene
- Polycarbonates & polycarbonate resins
- Polymeric isocyanates
- Polymethylene polyphenyl isocyanate
- Toluene diisocyanate

Table A-39. Industrial Sources of Polychlorinated Biphenyl (PCB) Emissions

Waste Incineration

At present, all other emissions are non-industrial resulting from incineration of PCB's, disposal of electrical equipment, and landfill sites.

Table A-40. Industrial Sources of Propylene Oxide Emissions

Production of:
- Dipropylene & tripropylene glycol
- Glycol ethers
- Polyester polyols
- Propyl glycol
- Propylene Oxide
- Surfactant glycol
- Urethane polyols

Table A-41. Industrial Sources of Radionuclides

Uranium from coal & coal combustion

Table A-42. Industrial Sources of Toluene Emissions

Production of:
- Acrylonitrile
- Benzaldehyde
- Benzene
- Benzyl chloride
- Benzoic acid
- Chloroprene/neoprene
- p-Cresol
- Dimethoate
- Ethylene-propylene rubber
- Ethylene-propylene terpolymer
- Malathion
- Phenol
- Polychloroprene
- Ronnel
- Styrene
- Toluene
- Toluene diisocyanate
- Toluene sulfonic acid
- Vinyl toluene
- Xylenes

Coke ovens
Gasoline distribution
Iron foundries - mold & core decomposition
Solvent evaporation - paints and coatings
- adhesive
- ink
- pharmaceutical
- degreasing
- textiles

Table A-43. Industrial Sources of Trichloroethylene Emissions

Methyl chloroform production
Perchloroethylene production from trichloroethylene
Solvent evaporation - metal degreasing
- adhesives
- sealants
- lubricants

Textiles - scouring
- dry cleaning
- tenter frame

Trichloroethylene production

Table A-44. Industrial Sources of Vinyl Chloride Emissions

Production of:
- Ethylene dichloride
- Methyl chloroform
- Polyvinyl chloride
- Polyvinylvinylidene chloride
- Vinyl chloride

Carpet backing adhesive

Table A-45. Industrial Sources of Vinylidene Chloride Emissions

Production of:
- Ethylene dichloride
- Polyvinyl chloride
- Polyvinylvinylidene chloride
- Vinylidene chloride

Coatings in textile manufacturing

Table A-46. Industrial Sources of Xylene Emissions

Production of:
- Dimethylterephthalate
- Ethylbenzene
- Isophthalic acid
- Maleic anhydride
- Methyl parathion
- Pesticides, agricultural
- Phthalic anhydride
- Terephthalic acid
- Xylene
- Xylene sulfonate - sodium salt
- Xylene sulfonate - ammonium salt
- Xylene sulfonate - potassium salt
- Xylidenes

Gasoline backblending
Gasoline distribution
Iron foundries - mold and core decomposition
Solvent - adhesives
- textiles
- degreasing